Short Communication

The effect of photoperiod on the initiation of the staminate inflorescence in different hybrids of *Zea mays*

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The sensitivity of eleven maize hybrids towards photoperiod was investigated under controlled environmental conditions. Initiation and development of the staminate inflorescence under long days were retarded markedly when compared with the short day treatment. Although there was some variation in sensitivity between hybrids, all reacted as short day plants.

Die gevoeligheid van elf mieliebasters ten opsigte van daglengte is met behulp van 'n groeikabinetprosedure bepaal. Die aanleg en ontwikkeling van die manlike bloeiwyse (pluim) is aansienlik vertraag onder langdae in vergelyking met kortdae. Alhoewel daar 'n verskil in sensitiwiteit tussen die basters onderling was, het almal as kortdagplante reageer.

Keywords: Initiation of staminate inflorescence, maize hybrids, photoperiod sensitivity, tassel initiation, *Zea mays* L.

Of the different environmental factors influencing the growth of maize, temperature (Holmes & Robertson 1959) and photoperiod (Becker 1955) are most important in determining the duration of growth of a particular genotype. It is generally accepted that maize is a short day plant (Whyte 1960; Becker 1955). Results obtained by Mes (1953), however, indicated that the variety, Potchefstroom Pearl, is not a short day plant. Some varieties were identified as indeterminate to photoperiod (Francis *et al.* 1969). From germination to dehiscence of the anthers the maize plant passes through two distinct phases of development. The first phase, i.e. differentiation of the vegetative parts (leaves), is followed by the elongation of the growing point and this marks the beginning of differentiation of the staminate inflorescence (Bonnet 1966; Hanway 1963). Studies by Kieselbach (1950) indicated that the effect of photoperiod on maize is exerted in the first few weeks of growth. The photoperiod influences morphological changes at the growing point. Therefore differences in photoperiod might be reflected in leaf numbers per stem (Robinson *et al.* 1967). It was pointed out by Kieselbach (1950) that differences in date of flowering or the length of period of growth may be due to differences in photoperiod occurring in different environments.

The heat unit accumulation constant (Gilmore & Rogers 1960) for a given crop varies from one region to another, particularly when the photoperiod varies (Holmes & Robertson 1959). According to Dijkhuis (1971) the introduction of day length into the formula used to calculate the summation constant for maize has been done rather indiscriminately and more research regarding the influence of day length on the development of maize is needed.

The aim of our study was to investigate the influence of photoperiod on the developmental morphology of the staminate inflorescence of different maize hybrids to evaluate their sensitivity to photoperiod. According to Francis *et al.* (1969) it was assumed that since the growth of maize is determinate and tasseling and silking are closely related in time, one could identify floral differentiation by the change from leaf initiation to the appearance of the staminate inflorescence. This appearance may occur during the first three weeks after planting (Kieselbach 1949).

Eleven South African hybrids of *Zea mays* L. were used, representing early (SA11, PNR22, SA200), midseason (PPK64R, SA5, SA100, SA4, SSM40, SSM42), and late (SR52, SA60) maturing genotypes. Five seeds were planted per pot and 10 pots per cultivar were used (five pots for each treatment). Two growth cabinets (Conviron) were set for a 16-h day (long day treatment) and a 9-h day (short day treatment), respectively. Both cabinets were illuminated at full intensity (300 μmol photons $m^{-2}s^{-1}$, measured 1 m from the ceiling) for 9 h, employing all fluorescent and incandescent lights. The illumination period of the long day cabinet was extended by adding 3 and 4 h of $^2/_5$ full intensity, respectively, at the beginning and end of the 'full' illumination period, so as not to increase the irradiance energy received by the plants of the long day treatment too drastically. Both cabinets were programmed to simulate changes in temperature and humidity of a typical 24-h period during November in Potchefstroom, based on meteorological data obtained from the local weather station.

Harvesting and dissecting and treatment of plants of each hybrid were carried out at 1 – 4 day intervals depending on the rate of change in growth stage. The stage of differentiation of the staminate inflorescence was determined by microscopical investigation and classified according to the description of the different stages by Bonnet (1966). To refine the classification, intermediate stages were identified by adding a minus or a plus to Bonnet's basic stages of development, thus distinguishing the following stages: A, A^+, B^-, B, B^+, C^-, C, C^+ etc. Numerical values were given to each stage (A = 1, A^+ = 2, B^- = 3, etc.) for a graphical presentation of the results. In this study, stage B^+ (i.e. stage 5) was regarded as the differentiation of the staminate inflorescence

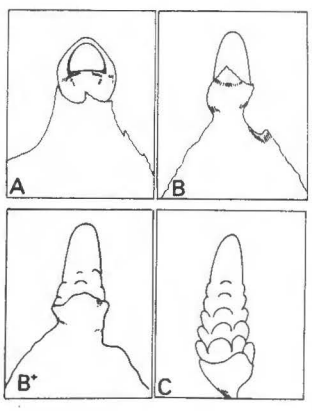

Figure 1 Initiation and first stages of development of the staminate inflorescence of *Zea mays*. Change from stage B to B+ (see text) was regarded as floral initiation.

(Bonnet 1966). At this stage small protuberances, representing branch primordia, appeared on the shoot apex (Figure 1). If the differentiation of the long day treatment took more than 6 days longer than that of the short day treatment, the hybrid was regarded as sensitive to photoperiod (Francis *et al.* 1969).

The effect of photoperiod on initiation and development of the staminate inflorescence with time, of five of the hybrids investigated, is presented in Figure 2. It is evident that development was much slower under long days. The difference in number of days from the emergence of the plants to the initiation of the staminate inflorescence ranged from 10 to >21 days in the hybrids investigated (Table 1). All the hybrids studied must therefore be regarded as sensitive to photoperiod, insofar as all of them react as short day plants. Although the two early maturing hybrids, SA200 and PNR22, were among the most sensitive to photoperiod, no clear relation existed between this sensitivity and the time needed to reach maturity. Since some of the commercially available maize cultivars are related to these hybrids, the effect of photoperiod should be kept in mind when employing formulae for predicting the interval between developmental stages.

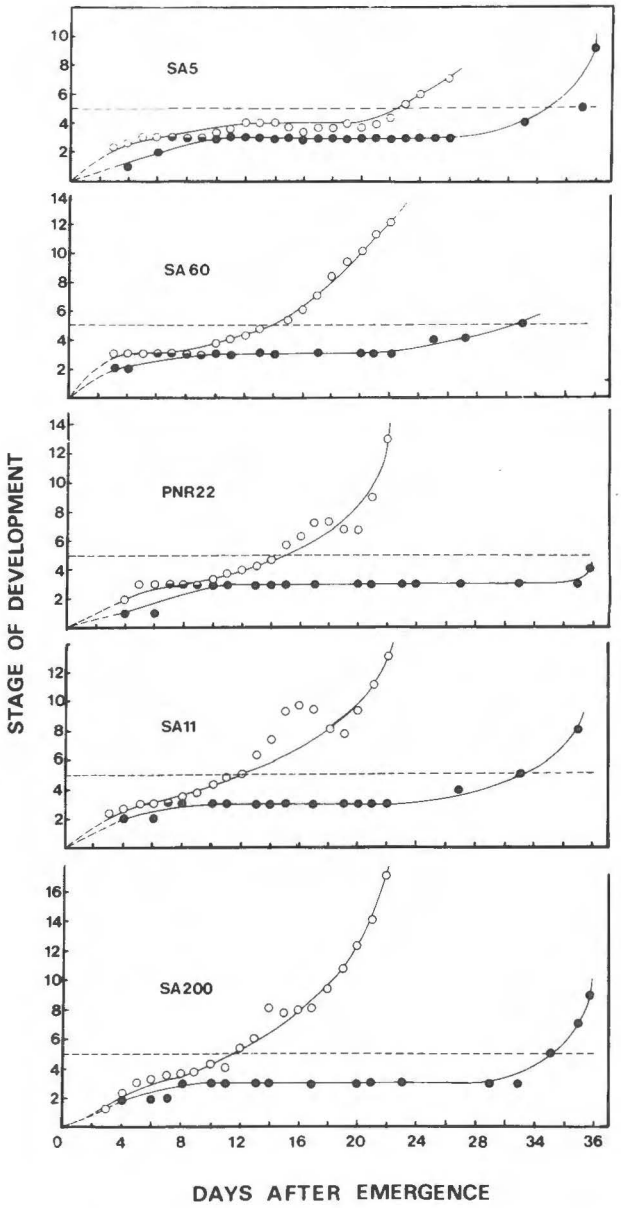

Figure 2 Development of the shoot apex after emergence with time of different *Zea mays* hybrids. Broken line indicates stage of floral initiation. o = 9-h photoperiod, ● = 16-h photoperiod.

Table 1 Days to differentiation of staminate inflorescence under short and long days and designation of sensitivity

Hybrid	Days to differentiation		Difference (sensitivity)
	Short days (9 h)	Long days (16 h)	
SA 100	13	35	22
SA 200	11	33	22
PNR 22	15	>36	>21
SA 11	12	31	19
SA 4	14	33	19
SA 60	14	31	17
SR 52	19	36	17
SSM 40	17	33	16
SSM 42	15	31	16
PPK64R	21	>36	>15
SA 5	23	33	10

When the planting date of the hybrid SA4 was delayed from 6 October to 26 November, a 34% decrease in yield occurred (F.J. Dijkhuis, pers. comm.). This was in spite of the fact that the length of the remaining growth season and the heat unit accumulation were adequate for reaching maturity. As the delay in planting date corresponds to an increase in day length of almost one and a half hours, the reduction in yield may be due partly to the effect of photoperiod on the morphological development of the shoot.

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